

Designation: D1555 - 09 D1555 - 16

Standard Test Method for Calculation of Volume and Weight of Industrial Aromatic Hydrocarbons and Cyclohexane¹

This standard is issued under the fixed designation D1555; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

- 1.1 This standard is for use in calculating the weight and volume of benzene, toluene, mixed xylenes, styrene, ortho-xylene, meta-xylene, para-xylene, cumene, ethylbenzene, 300 to 350°F and 350 to 400°F aromatic hydrocarbons, and cyclohexane. A method is given for calculating the volume at 60°F from an observed volume at *t*°F. Table 1 lists the density *in pounds* <u>Vacuo</u> per gallon-at 60°F for high purity chemicals.chemicals used to develop the relationship. Densities (or weights) "*in vacuo*" represent the true density (or weight) if measured in a vacuum without the buoyancy effect of air acting on the liquid. It is representative of the actual amount of product present. Densities (or weights) "*in air*" represent what would actually be measured on a scale. The difference is on the order of 0.13 %. Modern densitometers measure density *in vacuo* and the ASTM recommends the use of *in vacuo* densities (or weights).
 - 1.2 Calculated results shall be rounded off in accordance with the rounding-off method of Practice E29.
- 1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.
 - 1.2.1 A complete SI unit companion standard has been developed in Test Method D1555M.
- 1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:²

D1217 Test Method for Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer

D1555M Test Method for Calculation of Volume and Weight of Industrial Aromatic Hydrocarbons and Cyclohexane [Metric]

D3505 Test Method for Density or Relative Density of Pure Liquid Chemicals

D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.2 Other Documents:

American Petroleum Society Research Project 44³

Patterson, J. B., and Morris, E. C. Metrologia, -31, 1994, pp. 277-288

NSRDS-NIST 75-121 TRC Thermodynamic Tables—Hydrocarbons, Supplement No. 121, April 30, 2001⁴

3. Significance and Use

3.1 This test method is suitable for use in calculating weights and volumes of the products outlined in Section 1. The information presented in this method can be used for determining quantities of the above-stated aromatic hydrocarbons in tanks, shipping containers, etc.

¹ This test method is under the jurisdiction of ASTM Committee D16 on Aromatic Hydrocarbons and Related Chemicals and is the direct responsibility of Subcommittee D16.01 on Benzene, Toluene, Xylenes, Cyclohexane and Their Derivatives.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's standard's Document Summary page on the ASTM website.

³ "Selected Values of Properties of Hydrocarbons and Related Compounds," prepared by American Petroleum Institute Research Project 44 at the Chemical Thermodynamics Center, Department of Chemistry, Texas A&M, College Station, TX.

⁴ Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

TABLE 1 Physical Properties

Product	Freezing Point °F	Boiling Point °F	60°F-Density in Vacuo at 60°F g/cc ^{A,B}	Density <i>in Vacuo</i> at 60°F lb/gal ^C	Density <i>in Air</i> at 60°F lb/gal ^D
Benzene	42.0	176.2	0.88373	7.3751	7.3662
Cumene	-140.9	306.3	0.86538	7.2219	7.2130
Cyclohexane	43.8	177.3	0.78265	6.5315	6.5225
Ethylbenzene	-139.0	277.1	0.87077	7.2669	7.2580
Styrene	-23.1	293.4	0.90979	7.5926	7.5837
Toluene	-139.0	231.1	0.87096	7.2685	7.2596
<i>m</i> -Xylene	-54.2	282.4	0.86784	7.2425	7.2336
<i>o</i> -Xylene	-13.3	291.9	0.88340	7.3723	7.3634
<i>p</i> -Xylene	55.9	281.0	0.86456	7.2151	7.2062

A Based on regression of 2001 TRC Thermodynamic Tables, Hydrocarbons, NSRDS-NIST 75-121 (April 30, 2001). The data is presented in Appendix X1.

Note 1—Densities (or weights) "in vacuo" represent the true density (or weight) if measured in a vacuum without the buoyancy effect of air acting on the liquid. It is representative of the actual amount of product present. Densities (or weights) "in air" represent what would actually be measured on a scale. The difference is on the order of 0.13 %. Modern densitometers measure density in vacuo and the ASTM and API recommend the use of in vacuo densities (or weights); however, the purchaser and seller should agree on which to use in their transactions.

4. Basic Data

- 4.1 Densities of <u>materials should be determined by measurement (see Section 7)</u>. Densities of pure materials at 60°F are derived may be estimated from densities furnished by NSRDS-NIST 75-121 (National Standard Reference Data Series—National Institute of Standards and Technology). Densities of impure materials should be determined by actual measurement (see Section 7).
- 4.2 The VCF (Volume Correction Factor) equations provided below were derived from the Volume Correction Tables presented in the previous edition of this standard, Method D1555-95. Although reported as based on the American Petroleum Institute Research Project 44, the actual documentation that could be found is incomplete. As regression of the NIST data (Appendix X1) provided VCFs that differ from the historical VCFs by only 0 to \pm 0.12 % (depending on the compound), thea decision was made to use the previous method's method's VCF tables.
- 4.3 The VCF tables were regressed with a commercially available data regression program (TableCurve 2D V4). However, any modern regression program should produce the same results.
- 4.4 The former VCF tables were based on data for compounds of the highest purity, used in American Petroleum Institutre Research Project 44 for which the purity is not clearly defined, but were reported to be usable for materials in the ranges indicated in Table 2. The data supporting this conclusion appears to be unavailable at the present time; however there is no reason to change this recommendation. If, depending on the composition of the impurities, there is reason to suspect that the VCF implementation procedures presented below do not apply to a particular impure product, a separate implementation procedure should be independently determined. This may be done by measuring the density of a representative sample at different temperatures throughout the expected working temperature range, regressing the data to obtain a temperature/density equation that best reproduces the observed data, and then dividing the constants of the temperature/density equation by the calculated density at 60°F. Alternatively, if the composition has been quantified one can use the VCFs of each component (if available) to calculate a weighted average density at different temperatures and then process the data as mentioned above.

TABLE 2 Application Range of Implementation Procedure

Impure Products	Range
Benzene	95 to 100%
Cumene	95 to 100%
Cyclohexane	90 to 100%
Ethylbenzene	95 to 100%
Styrene	95 to 100%
Toluene	95 to 100%
Mixed Xylenes	All proportions
<i>m</i> -Xylene	95 to 100%
o-Xylene	95 to 100%
p -Xylene	94 to 100%
300-350°F Aromatic Hydrocarbons	All proportions
350-400°F Aromatic Hydrocarbons	All proportions

B Specific Gravity has been deleted from this table as unnecessary to this standard. If needed, divide 60°F density in g/cc divided by 0.999016 g/cc. See Appendix X2.

^C Produced by multiplying the density in vacuo at 60°F in g/cc by 0.345404388.345404452 and rounding to 4 decimal places.

^D Produced using $\frac{1}{9} = \frac{\text{(Density Density} - g/cc}{\text{(In air} \cdot 1.000149925971.000149926} - \frac{0.00119940779543}{\text{(Density} \cdot 1.0001499407795} \cdot \frac{0.001199407795}{\text{(Density} \cdot 1.000149925971.000149926} - \frac{0.00119940779543}{\text{(Density} \cdot 1.000149925971.000149926} - \frac{0.001199407795}{\text{(Density} \cdot 1.000149926} - \frac{0.00119940795}{\text{(Density} \cdot 1.000149926} - \frac{0.001199407795}{\text{($

5. Volume Correction Factor Implementation Procedure

5.1 The following general equation is used to generate the Volume Correction Factors:

 $VCF = a + bt + ct^{2} + dt^{3} + et^{4}$ $VCF = a + bt + ct^{2} + dt^{3} + et^{4}$ (1)

where:

 $\underline{t} = \underline{\text{temperature in } ^{\circ}F}$

where:

 $t = \text{temperature in } \circ F$

and constants a through e are specific to each compound (presented in Table 3).

- 5.1.1 Temperature may be entered in tenths of a degree Fahrenheit.
- 5.1.2 The finalcalculated result is rounded to 5 places past the decimal, the appropriate significant figures if it is to be reported and not rounded if to be used in another calculation. No intermediate rounding or truncation should be done.
 - 5.1.3 The equations are valid for liquid product up to 140°F (150°F for *p*-xylene).
- 5.1.4 This implementation procedure replaces the printed tables of the table in a previous edition of this Method standard (Method D1555-95) for determining VCFs. The implementation procedure is the Standard, not the printed tables table. However, a printout of the implementation procedure the printed table is provided in 1°F increments for the user's user's convenience (Table 4).

6. Use of the Implementation Procedure

6.1 <u>Convert Volume Reduction</u>—to $60^{\circ}F$ —Enter the appropriate equation with the temperature to the nearest 0.1 degree Fahrenheit at which the bulk volume was measured (temperature t). After performing the mathematical operations, round the resulting VCF to 5 places past the decimal. Multiply the bulk volume measurement at temperature t by the VCF.

Note 1—The purchaser and seller should agree on a reasonable policy in regard to rounding of final numbers in all computations. Rounding the final weight or volume to five significant figures is, in most cases, also acceptable.

- 6.1.1 Example 1—What is the volume at 60°F of a tank car of p-xylene whose volume was measured to be 9280 gal at a mean temperature of 88.7°F?
- 6.1.1.1 Enter Eq 1 with 88.7 88.7°F and the appropriate constants from Table 3 into Eq 1 to calculate a VCF of 0.98414. The 0.984143256178277. Multiply the volume at 60°F is:88.7°F by the VCF to obtain the volume at 60°F.

9280-0.98414 = 9132.8 gal

 $9280 \text{ } \text{gal} \times 0.984143256178277 = 9,132.84941733442 \text{ } \text{or} \text{ } 9133 \text{ } \text{gal} \text{ } 7592263/\text{astm-d} 1555-16$

If this value is to be reported, it may be rounded as required by the user. The unrounded intermediate value should be used for additional calculations.

6.2 Converting Volume to Weight for Chemicals Listed in Table 1—Multiply the volume in gallons at 60°F (5 digits) by the appropriate density in pounds per gallon at 60°F (see Table 1 and Table 1 Note).

6.2.1 Example 2—What is the weight of p-xylene whose net volume is 9132.8 gal?

6.2.1.1 The weight is:

 $9132.8 \cdot 7.2151 = 65,894$ lb in vacuo

or

 $9132.8 \cdot 7.2062 = 65,813$ lb in air

TABLE 3 VCF Constants

Product	a	b	С	d	e <u>E</u>
Benzene	1.038382492	-6.2307 × 10 ⁻⁴	-2.8505 × 10 ⁻⁷	1.2692 × 10 ⁻¹⁰	0
Cumene	1.032401114	-5.3445×10^{-4}	-9.5067×10^{-8}	3.6272×10^{-11}	0
Cyclohexane	1.039337296	-6.4728×10^{-4}	-1.4582×10^{-7}	1.03538×10^{-10}	0
Ethylbenzene	1.033346632	-5.5243×10^{-4}	8.37035×10^{-10}	-1.2692×10^{-9}	5.55061×10^{-12}
Styrene	1.032227515	-5.3444×10^{-4}	-4.4323×10^{-8}	0	0
Toluene	1.035323647	-5.8887×10^{-4}	2.46508×10^{-9}	-7.2802×10^{-12}	0
m-Xylene ^A	1.031887514	-5.2326×10^{-4}	-1.3253×10^{-7}	-7.35960×10^{-11}	0
o-Xylene	1.031436449	-5.2302×10^{-4}	-2.5217×10^{-9}	-2.13840×10^{-10}	0
<i>p</i> -Xylene	1.032307000	-5.2815×10^{-4}	-1.8416×10^{-7}	1.89256×10^{-10}	0
300-350°F	1.031118000	-5.1827×10^{-4}	-3.5109×10^{-9}	-1.98360×10^{-11}	0
350-400°F	1.029099000	-4.8287×10^{-4}	-3.7692×10^{-8}	3.78575×10^{-11}	0

^Aand Mixed Xylenes.



TABLE 4 Volume Correction Factors

Volume Correction to 60°F											
Temperature °F	Benzene	Cumene	Cyclohexan	e Ethylbenzene	Styrene	Toluene	m-Xylene and Mixed Xylenes	o-Xylene	<i>p</i> -Xylene	300 to 350° Aromatic Hydrocarbons	350 to 400° Aromatic Hydrocarbons
-5.0						1.03827					
-4.0						1.03768		•••		•••	
-3.0						1.03709					
-2.0						1.03650					
-1.0						1.03591				•••	
0.0						1.03532					
1.0						1.03473					
2.0						1.03415					
3.0						1.03356					
4.0						1.03297					
5.0		1.02973		1.03058		1.03238	1.02927	1.02882		1.02853	1.02668
6.0		1.02919		1.03003		1.03179	1.02874	1.02830		1.02801	1.02620
7.0		1.02866		1.02948		1.03120	1.02822	1.02778		1.02749	1.02572
8.0		1.02812		1.02893		1.03061	1.02769	1.02725		1.02697	1.02523
9.0		1.02758		1.02837		1.03002	1.02717	1.02673		1.02645	1.02475
10.0		1.02705		1.02782		1.02944	1.02664	1.02621		1.02593	1.02427
11.0		1.02651		1.02727		1.02885	1.02612	1.02568		1.02542	1.02378
12.0		1.02597		1.02672		1.02826	1.02559	1.02516		1.02490	1.02330
13.0		1.02544		1.02616		1.02767	1.02506	1.02464		1.02438	1.02282
14.0		1.02490		1.02561		1.02708	1.02454	1.02411		1.02386	1.02233
15.0		1.02436		1.02506	1.02420	1.02649	1.02401	1.02359		1.02334	1.02185
16.0		1.02383		1.02450	1.02367	1.02590	1.02348	1.02307		1.02282	1.02136
17.0		1.02329		1.02395	1.02313	1.02531	1.02295	1.02254		1.02231	1.02088
18.0		1.02275		1.02340	1.02259	1.02472	1.02243	1.02202		1.02179	1.02040
19.0		1.02221		1.02284	1.02206	1.02414	1.02190	1.02150		1.02127	1.01991
20.0		1.02167		1.02229	1.02152	1.02355	1.02137	1.02097		1.02075	1.01943
21.0		1.02114		1.02174	1.02098	1.02296	1.02084	1.02045		1.02023	1.01894
22.0		1.02060		1.02118	1.02045	1.02237	1.02031	1.01993		1.01971	1.01846
23.0		1.02006		1.02063	1.01991	1.02178	1.01978	1.01940		1.01920	1.01797
24.0		1.01952	(144	1.02007	1.01938	1.02119	1.01925	1.01888		1.01868	1.01749
25.0		1.01898		1.01952	1.01884	1.02060	1.01872	1.01836		1.01816	1.01700
26.0		1.01844	(11100	1.01896	1.01830	1.02001	1.01819	1.01783		1.01764	1.01652
27.0		1.01790		1.01841	1.01777	1.01943	1.01766	1.01731		1.01712	1.01603
28.0		1.01736		1.01785	1.01723	1.01884	1.01713	1.01679		1.01660	1.01555
29.0		1.01682		1.01730	1.01669	1.01825	1.01660	1.01626		1.01608	1.01506
30.0		1.01628		1.01674	1.01615	1.01766	1.01607	1.01574		1.01557	1.01458
31.0		1.01574		1.01619	1.01562	1.01707	1.01554	1.01521		1.01505	1.01409
32.0		1.01520		1.01563	1.01508	1.01648	1.01501	1.01469		1.01453	1.01361
33.0		1.01466		1.01508	1.01454	1.01589	1.01447	1.01417		1.01401	1.01312
34.0			/catalog/s	tan 1.01452 Sis	1.01401	5 1.01530	4 1.01394	1.01364	592263/	as 1.01349	55 1.01264
35.0		1.01358		1.01397	1.01347	1.01472	1.01341	1.01312		1.01297	1.01215
36.0		1.01304		1.01341	1.01293	1.01413	1.01287	1.01259		1.01245	1.01167
37.0		1.01250		1.01285	1.01239	1.01354	1.01234	1.01207		1.01194	1.01118
38.0		1.01196		1.01230	1.01185	1.01295	1.01181	1.01155		1.01142	1.01070
39.0		1.01142		1.01174	1.01132	1.01236	1.01127	1.01102		1.01090	1.01021
40.0		1.01087		1.01118	1.01132	1.01230	1.01074	1.01102		1.01038	1.00973
41.0	•••	1.01037		1.01063	1.01076	1.01118	1.01074	1.00997		1.00986	1.00924
42.0	•••	1.01033		1.01003	1.01024	1.01059	1.01021	1.00945		1.00934	1.00924
43.0	 1.01107	1.00975		1.00951	1.00976	1.01003	1.00907	1.00343		1.00882	1.00827
44.0	1.01107	1.00923	1.01058	1.00895	1.00863	1.01001	1.00860	1.00840		1.00831	1.00778
45.0	1.00978	1.00816	1.01030	1.00840	1.00809	1.00342	1.00807	1.00788		1.00779	1.00770
46.0	1.00978	1.00010	1.00992	1.00784	1.00303	1.00824	1.00753	1.00735	•••	1.00773	1.00681
47.0	1.00913	1.00702	1.00920	1.00784	1.00733	1.00024	1.00753	1.00733		1.00727	1.00632
48.0	1.00646	1.00708	1.00660	1.00728	1.00701	1.00705	1.00699	1.00630		1.00673	1.00532
49.0	1.00763	1.00533	1.00794	1.00672	1.00547	1.00708	1.00546	1.00630		1.00623	1.00564
49.0 50.0	1.00718	1.00599	1.00728	1.00560	1.00593	1.00547	1.00592	1.00578		1.00571	1.00535
51.0	1.0053	1.00545	1.00596	1.00504	1.00539	1.00589	1.00538	1.00525		1.00519	1.00487
52.0	1.00523	1.00436	1.00530	1.00448	1.00432	1.00471	1.00431	1.00420		1.00416	1.00389
53.0	1.00458	1.00381	1.00464	1.00393	1.00378	1.00412	1.00377	1.00368		1.00364	1.00341
54.0	1.00393	1.00327	1.00398	1.00337	1.00324	1.00353	1.00323	1.00315		1.00312	1.00292
55.0	1.00327	1.00272	1.00331	1.00281	1.00270	1.00294	1.00270	1.00263	1.00010	1.00260	1.00243
56.0	1.00262	1.00218	1.00265	1.00224	1.00216	1.00235	1.00216	1.00210	1.00219	1.00208	1.00195
57.0	1.00196	1.00164	1.00199	1.00168	1.00162	1.00176	1.00162	1.00158	1.00164	1.00156	1.00146
58.0	1.00131	1.00109	1.00132	1.00112	1.00108	1.00118	1.00108	1.00105	1.00109	1.00104	1.00097
59.0	1.00066	1.00055	1.00066	1.00056	1.00054	1.00059	1.00054	1.00053	1.00054	1.00052	1.00049
60.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
61.0	0.99934	0.99945	0.99933	0.99944	0.99946	0.99941	0.99946	0.99947	0.99945	0.99949	0.99951
62.0	0.99869	0.99891	0.99867	0.99888	0.99892	0.99882	0.99892	0.99895	0.99890	0.99897	0.99903
63.0	0.99803	0.99836	0.99801	0.99832	0.99838	0.99823	0.99838	0.99842	0.99835	0.99845	0.99854
64.0	0.99737	0.99782	0.99734	0.99775	0.99784	0.99764	0.99784	0.99790	0.99780	0.99793	0.99805
65.0	0.99671	0.99727	0.99668	0.99719	0.99730	0.99706	0.99730	0.99737	0.99725	0.99741	0.99756

TABLE 4 Continued

						TABLE 4	Continued					
						Volume Cor	rection to 60°F					
Geb. 0.99661 0.99672 0.99601 0.99663 0.99676 0.99647 0.99675 0.99684 0.99676 0.99677 0.99576 0.99579 0.99586 0.99676 0.99676 0.99676 0.99676 0.99676 0.99677 0.99676 0.99676 0.99677 0.99677 0.99678 0.99676 0.99676 0.99677 0.99677 0.99677 0.99677 0.99678		Benzene	Cumene	Cyclohexane	Ethylbenzene	Styrene	Toluene	and Mixed	o-Xylene	<i>p</i> -Xylene	300 to 350° Aromatic Hydrocarbons	350 to 400° Aromatic Hydrocarbons
67.0 0.99540 0.99616 0.99505 0.99607 0.98622 0.99588 0.99622 0.99632 0.99616 0.9966 68.0 0.99474 0.99474 0.99683 0.99568 0.99568 0.99568 0.996												
68.0											0.99689	0.99708
69.0											0.99637	0.99659
70.0 0.98341 0.99454 0.99355 0.99438 0.99460 0.99417 0.99458 0.99474 0.99450 0.9947 71.0 0.99275 0.99399 0.9939 0.99356 0.99390 0.99352 0.99352 0.99352 0.99352 0.99352 0.99352 0.99352 0.99352 0.99352 0.99352 0.99352 0.99353 0.9935											0.99585	0.99610
71.0 0.99275 0.99399 0.99268 0.99382 0.99406 0.99324 0.99404 0.99341 0.9936 0.9937 0.9927 0.99204 0.99209 0.99293 0.99293 0.99293 0.99295 0.99295 0.99293 0.99295 0.99											0.99533	0.99561
T20											0.99482	0.99513
73.0											0.99430	0.99464
75.0 0.99017 0.99180 0.99010 0.99166 0.99196 0.99167 0.99187 0.99187 0.99178 0.99179 76.0 0.98944 0.99180 0.99100 0.99165 0.99105 0.99165 0.99181 0.99119 0.99177 0.98844 0.98910 0.99070 0.98868 0.99094 0.99095 0.99088 0.99082 0.99182 0.99185 0.99088 0.99185 0.99088 0.99081 0.98											0.99378	0.99415
75.0 0.99010 0.99101 0.99130 0.99117 0.99121 0.99114 0.99174 0.9921 76.0 0.88944 0.99125 0.98935 0.99098 0.99038 0.99105 0.99063 0.9917 78.0 0.88811 0.99901 0.98801 0.99081 0.99804 0.99063 0.9917 78.0 0.88744 0.98906 0.98604 0.99081 0.98814 0.99908 0.99002 0.99052 0.99080 81.0 0.98674 0.98906 0.98667 0.98867 0.98814 0.98969 0.99080 0.98667 0.98814 0.98764 0.98823 0.99080 0.98614 0.9876 0.98841 0.98760 0.98841 0.98760 0.98841 0.98678 0.98686 0.98041 0.98841 0.98686 0.98641 0.98760 0.98842 0.988 83.0 0.98749 0.98633 0.98676 0.98640 0.98642 0.98842 0.98841 0.98642 0.98842 0.98842 0.98842 0.98842 0.											0.99326	0.99366
76.0 0.98944 0.99125 0.98935 0.99096 0.99135 0.99078 0.99158 0.99159 0.99179 77.0 0.98817 0.99070 0.98888 0.99943 0.99007 0.98994 0.99078 0.99052 0.99008 0.99078 0.99181 0.99078 0.99181 0.99078 0.99181 0.99078 0.99181 0.99078 0.99081 0.99082 0.99082 0.99088 0.98081 0.98814 0.98940 0.98082 0.99082 0.99082 0.99082 0.99082 0.99082 0.99082 0.99082 0.99082 0.99082 0.99082 0.99082 0.98083 0.98814 0.98687 0.98881 0.98681 0.98681 0.98681 0.98681 0.98681 0.98681 0.98681 0.98684 0.98760 0.98814 0.98766 0.98884 0.98764 0.98686 0.98630 0.98676 0.98764 0.98686 0.98630 0.98676 0.98764 0.98686 0.98630 0.98676 0.98764 0.98686 0.98630 0.98676 0.98764 0.98686 0.98630 0.98676 0.98764 0.98686 0.98630 0.98676 0.98764 0.98686 0.98630 0.98664 0.98686 0.98630 0.98664 0.98686 0.98630 0.98664 0.98689 0.98686 0.98680 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686											0.99274	0.99318
77.0 0.98817 0.99015 0.98881 0.999073 0.99081 0.99887 0.99022 0.99023 0.99052 0.99063 0.99063 0.99063 0.99063 0.9906 0.98074 0.98937 0.98881 0.98996 0.98078 0.98081 0.98987 0.9881 0.98969 0.99073 0.98857 0.98876 0.98678 0.98678 0.98671 0.98874 0.98979 0.98879 0.98879 0.98879 0.98879 0.98879 0.98879 0.98879 0.98871 0.98868 0.98741 0.98797 0.98868 0.98771 0.98876 0.98871 0.98876 0.98868 0.98874 0.98760 0.98811 0.987870 0.98876 0.98867 0.98676 0.98686 0.98470 0.98847 0.98736 0.98676 0.98841 0.98736 0.98676 0.98686 0.98676 0.98686 0.98676 0.98666 0.98534 0.98560 0.98527 0.98578 0.98676 0.986266 0.98534 0.98520 0.98586 0.98678 0.98626 0.98534											0.99222	0.99269
78.0 0.9811 0.99015 0.98801 0.98987 0.99927 0.99840 0.99022 0.99062 0.99068 0.9907 0.9008 0.9908 0.99090 0.98080 0.99090 0.98080 0.99090 0.98080 0.99090 0.98080 0.99090 0.98080 0.99090 0.98080 0.99090 0.98080 0.99090 0.98080 0.98080 0.98081 0.980											0.99170	0.99220
Phys. 0.9874 0.98906 0.98734 0.98930 0.98973 0.98881 0.98961 0.98067 0.98874 0.98878 0.98861 0.98867 0.98878 0.98867 0.98878 0.98867 0.98878 0.98869 0.98867 0.98867 0.98878 0.98869 0.98869 0.98869 0.98868											0.99118	0.99171
80.0 0.98678 0.9860 0.98667 0.98874 0.98919 0.98823 0.98914 0.98947 0.98896 81.0 0.98611 0.98610 0.98611 0.98610 0.986181 0.98650 0.98655 0.98655 0.98684 0.98686 82.0 0.98644 0.98766 0.98650 0.98646 0.98766 0.98686 0.98646 0.98766 0.98686 0.98646 0.98760 0.98686 0.98646 0.98760 0.98686 0.98646 0.98760 0.98686 0.98641 0.98786 0.98686 0.98641 0.98686 0.98641 0.98686 0.98647 0.98760 0.98686 0.98686 0.98641 0.98686 0.98686 0.98680 0.98686											0.99066	0.99122
81.0 0.98611 0.98611 0.98634 0.98676 0.98865 0.98665 0.98684 0.98686 82.0 0.98786 0.98686 83.0 0.98478 0.98786 0.98867 0.98786 0.98868 83.0 0.98478 0.98678 0.98868 83.0 0.98478 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98686 0.98678 0.98686 0.98678 0.98686 0.98678 0.98689 0.986											0.99014	0.99074
82.0 0.98544 0.98796 0.98367 0.98704 0.98705 0.98805 0.98814 0.98731 0.988 84.0 0.98411 0.98686 0.98407 0.98704 0.98705 0.986846 0.98730 0.98731 0.988 84.0 0.98411 0.98686 0.98400 0.98647 0.98702 0.98587 0.98695 0.98736 0.98678 0.98731 0.9888 85.0 0.98247 0.98637 0.98333 0.98591 0.98648 0.98528 0.98641 0.98633 0.98620 0.98238 0.98641 0.98227 0.98277 0.98576 0.98260 0.98271 0.98591 0.98648 0.98528 0.98641 0.98630 0.98500 0.98528 0.98641 0.98529 0.98641 0.98620 0.9873 0.98521 0.98641 0.98620 0.9873 0.98521 0.98620 0.9873 0.98521 0.98621 0.9873 0.98528 0.98641 0.98620 0.9873 0.98528 0.98641 0.98620 0.9873 0.98528 0.98641 0.98620 0.98620 0.9873 0.98528 0.98641 0.98620 0.9873 0.98528 0.98641 0.98620 0.9873 0.98529 0.98620 0.9873 0.98529 0.98620 0.9873 0.98529 0.98620 0.9873 0.98529 0.98620 0.9873 0.98529 0.98620 0.9873 0.98529 0.98620 0.9873 0.98529 0.98620 0.9973 0.98529 0.98528 0.98642 0.98620 0.9973 0.98529 0.98520 0.98520 0.98520 0.98520 0.98520 0.997875 0.98520 0.98520 0.98520 0.98520 0.98520 0.98520 0.99782 0.98520 0.99782 0.98520 0.99782 0.98520 0.99782 0.98520 0.99782 0.98520 0.99782 0.98520 0.99782 0.98520 0.99782 0.99820 0.99772 0.99820 0.99782 0.99820 0.99820 0.99823 0.99782 0.99820 0.99820 0.99823 0.99782 0.99820 0.99823 0.99782 0.99820 0.99822 0.99820 0.99823 0.99782 0.9982											0.98962	0.99025
83.0 0.98478 0.98741 0.98400 0.98704 0.98756 0.98756 0.98758 0.98738 0.98676 0.98738 84.0 0.98411 0.98681 0.98680 0.98576 0.98738 0.98676 0.98738 85.0 0.98344 0.98631 0.98333 0.98567 0.98695 0.98676 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98678 0.98738 0.98738 0.98678 0.98738 0.98738 0.98678 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98738 0.98749 0.98738 0.98749 0.98738 0.98749 0.98740 0.98749											0.98910	0.98976
84.0 0.98411 0.98686 0.98400 0.98691 0.98702 0.98528 0.98675 0.98736 0.98676 0.98591 0.98628 0.9861 0.98630 0.98630 0.98654 0.9868 87 0 0.98277 0.98576 0.98686 0.98644 0.98640 0.98411 0.98530 0.98654 0.9868 87 0 0.98277 0.98576 0.98666 0.98441 0.98411 0.98631 0.98656 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98411 0.98362 0.98411 0.98233 0.98472 0.98432 0.98436 0.98363 0.98246 0.98331 0.98234 0.98367 0.98367 0.98411 0.98367 0.98412 0.98366 0.98636 0.98632 0.98623 0.98412 0.98366 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 0.98636 <											0.98859	0.98927
85.0 0.983444 0.98631 0.98534 0.98649 0.98568 0.98620 0.98534 0.98469 0.98560 0.98560 0.98560 0.98561 0.98541 0.98541 0.98541 0.98541 0.98541 0.98541 0.98541 0.98541 0.98466 0.98531 0.98577 0.98599 0.98588 80.0 0.98143 0.98466 0.98132 0.98421 0.98485 0.98331 0.98555 0.98599 0.98500 80.0 0.98076 0.98411 0.98086 0.98421 0.98432 0.98422 0.98422 0.98433 0.98424 90.0 0.98090 0.98336 0.97999 0.98307 0.98237 0.98317 0.98312 0.98442 0.98426 91.0 0.97875 0.98246 0.97863 0.98137 0.98268 0.98116 0.98257 0.98313 0.98231 0.9826 93.0 0.97672 0.98137 0.98244 0.98057 0.98202 0.98313 0.9824 94.0 0.97740 0.9803											0.98807	0.98878
86.0 0.98277 0.98566 0.98620 0.98544 0.98640 0.98411 0.98530 0.98654 0.98688 87.0 0.98143 0.98646 0.98141 0.98525 0.98475 0.98525 0.98476 0.98525 0.98452 0.98453 0.98688 0.98076 0.98141 0.98036 0.98065 0.98364 0.98411 0.98327 0.98376 0.98472 0.98388 0.98498 90.0 0.98099 0.98336 0.98377 0.98234 0.98366 0.98266 0.9832 91.0 0.97842 0.98301 0.97861 0.98194 0.98266 0.98116 0.98257 0.98316 0.98266 0.9812 92.0 0.97867 0.98194 0.98266 0.98116 0.98257 0.98310 0.98260 0.98175 0.98320 0.98260 0.98266 0.9816 0.99827 0.98320 0.98176 0.98260 0.98276 0.98080 0.98160 0.97999 0.94147 0.98260 0.98119 0.9826 0.98160 0.997891											0.98755	0.98829
87.0 0.88210 0.98521 0.98199 0.98477 0.98540 0.98411 0.98531 0.98577 0.98570 0.9858 88.0 0.98107 0.98076 0.98411 0.98065 0.98426 0.98431 0.98332 0.98476 0.98525 0.98453 0.9858 89.0 0.98076 0.98411 0.98065 0.98364 0.98431 0.98233 0.98422 0.98472 0.98398 0.9848 90.0 0.98009 0.98356 0.97998 0.98307 0.98377 0.98234 0.98362 0.98482 0.98484 91.0 0.97942 0.98301 0.97931 0.98231 0.98323 0.98412 0.98366 0.98286 92.0 0.97875 0.98246 0.97863 0.98194 0.98268 0.98116 0.98226 0.98266 0.98339 0.97704 0.98190 0.97796 0.98197 0.98241 0.98067 0.98202 0.98260 0.98175 0.98241 0.98369 0.98261 0.98257 0.98241 0.98261 0.98257 0.98241 0.98261 0.98257 0.98261 0.98257 0.98241 0.98261 0.98257 0.98241 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98257 0.98261 0.98261 0.97622 0.97624 0.97762 0.97762 0.97764 0.9											0.98703	0.98781
88.0 0.88143 0.98466 0.98122 0.98421 0.98431 0.98232 0.98422 0.98427 0.98384 0.98235 0.98422 0.98368 0.98431 0.98234 0.98367 0.98386 0.98431 0.98244 0.98367 0.98342 0.98489 0.98368 0.98489 0.98301 0.97931 0.98237 0.98275 0.98312 0.98369 0.98246 0.98323 0.98175 0.98312 0.98369 0.98246 0.98332 0.98175 0.98312 0.98368 0.98312 0.98369 0.98260 0.98136 0.98267 0.98313 0.98231 0.98031 0.98031 0.98031 0.98031 0.98026 0.98116 0.98026 0.98131 0.98262 0.98161 0.98027 0.98161 0.98267 0.98131 0.98313 0.98313 0.98313 0.98313 0.98314 0.98020 0.98167 0.98262 0.98161 0.98027 0.98161 0.98262 0.98162 0.98020 0.98164 0.98020 0.98167 0.98143 0.98261 0.98322 0											0.98651	0.98732
89.0 0.98076 0.98411 0.98065 0.98364 0.98431 0.98233 0.98422 0.98472 0.98388 0.9848 90.0 0.980076 0.98386 0.9938 0.98482 0.9848 91.0 0.93742 0.98301 0.97931 0.98251 0.98323 0.98175 0.98312 0.98366 0.98286 0.9838 92.0 0.97875 0.98246 0.97863 0.98194 0.98280 0.98116 0.98267 0.98313 0.98231 0.9838 93.0 0.97807 0.98190 0.97796 0.981937 0.98246 0.98086 0.98116 0.98262 0.98260 0.98175 0.98290 0.97790 0.98193 0.97790 0.98190 0.97790 0.98190 0.97790 0.98190 0.97790 0.98190 0.97790 0.98190 0.97790 0.98190 0.97790 0.98190 0.97790 0.98190 0.97620 0.98175 0.9829 0.9810 0.97740 0.98135 0.9729 0.98080 0.98160 0.97990 0.98147 0.98207 0.9819 0.98260 0.98175 0.9829 0.98100 0.97692 0.98092 0.98154 0.98093 0.98160 0.97692 0.98092 0.98154 0.98093 0.98160 0.97692 0.97693 0.97760 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.97694 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.97692 0.97694 0.976											0.98599	0.98683
90.0 0.98009 0.98356 0.9798 0.98307 0.98377 0.98234 0.98367 0.98419 0.98362 0.98369 91.0 0.97942 0.98301 0.97936 0.98266 0.98369 92.0 0.97875 0.98266 0.9833 0.98175 0.98268 0.98116 0.98257 0.98313 0.98231 0.983 93.0 0.97807 0.98190 0.97796 0.98137 0.98244 0.98057 0.98202 0.98260 0.98175 0.982 94.0 0.97740 0.98135 0.97729 0.98080 0.98160 0.97990 0.98147 0.98207 0.98119 0.982 95.0 0.97673 0.98080 0.97662 0.98024 0.98106 0.97940 0.98092 0.98154 0.98063 0.981 97.0 0.97538 0.99700 0.97527 0.97910 0.97897 0.97822 0.97982 0.98081 0.98090 0.97662 0.98057 0.98202 0.98154 0.98063 0.981 97.0 0.97538 0.97970 0.97527 0.97910 0.97897 0.97822 0.97982 0.98048 0.97952 0.980 99.0 0.97470 0.97915 0.97460 0.97853 0.97943 0.97763 0.97927 0.97996 0.97896 0.98099 0.97403 0.97853 0.97970 0.97538 0.97970 0.97527 0.97910 0.97897 0.97822 0.97982 0.98048 0.97939 0.97893 0.97797 0.97882 0.97764 0.97871 0.97943 0.97840 0.97871 0.97941 0.97881 0.97841 0.97883 0.97884 0.97562 0.97861 0.97852 0.97861 0.97851 0.97883 0.97884 0.97562 0.97861 0.97883 0.97884 0.97562 0.97861 0.97883 0.97884 0.97562 0.97861 0.97883 0.97884 0.97562 0.97861 0.97883 0.97883 0.97884 0.97484 0.97672 0.97881 0.97883 0.97884 0.97484 0.97672 0.97881 0.97883 0.97884 0.97484 0.97672 0.97881 0.97883 0.97883 0.97884 0.97484 0.97672 0.97881 0.97883 0.97884 0.97484 0.97672 0.97881 0.97883 0.97883 0.97884 0.97484 0.97672 0.97883 0.97883 0.97883 0.97883 0.97884 0.97883 0.97883 0.97884 0.97883 0.97883 0.97883 0.97883 0.97883 0.97883 0.97883 0.97884 0.97883 0.97883 0.97883 0.97883 0.97883 0.97883 0.97883 0.97884 0.97883 0.97883 0.97883 0.97883 0.97884 0.97883 0.97883 0.97884 0.97883 0.97883 0.97883 0.97884 0.97883 0.97883 0.97883 0.97884 0.97883 0.97884 0.97883 0.97883 0.97883 0.97883 0.97883 0.97884 0.97883 0.97883 0.97883 0.97883 0.97883 0.97883 0.97883											0.98547	0.98634
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99.0 0.97403 0.97859 0.97393 0.97767 0.97884 0.97704 0.97871 0.97881 0.97704 0.97881 0.97704 0.97335 0.97704 0.97335 0.97704 0.97335 0.97704 0.97335 0.97706 0.97781 0.97890 0.97781 0.97891 0.97288 0.97709 0.97288 0.97780 0.97587 0.97761 0.97837 0.97728 0.9781 0.9700 0.97200 0.97694 0.97191 0.97626 0.97725 0.97528 0.97706 0.97784 0.97722 0.978 0.9771 0.9700 0.97000 0.97632 0.97032 0.97630 0.97710 0.97000 0.97000 0.97632 0.97056 0.9751 0.97610 0.97706 0.97730 0.97616 0.977 0.97500 0.97004 0.97583 0.97705 0.97512 0.97617 0.97410 0.97595 0.97677 0.97560 0.977 0.97560 0.977 0.97500 0.97610 0.97004 0.97583 0.97056 0.97512 0.97617 0.97410 0.97595 0.97677 0.97560 0.977 0.97560 0.977 0.97500 0.97610 0.											0.98079	0.98194
100.0 0.97335 0.97804 0.97325 0.97740 0.97830 0.97645 0.97816 0.97890 0.97784 0.979 101.0 0.97268 0.977694 0.977191 0.97626 0.97725 0.97766 0.97761 0.97828 0.9760 0.97784 0.97672 0.978 103.0 0.97132 0.97638 0.97123 0.97569 0.97617 0.97469 0.97651 0.97730 0.97616 0.977 104.0 0.97064 0.97583 0.97056 0.97512 0.97617 0.97469 0.97550 0.97677 0.97504 0.97676 0.97504 0.97625 0.97504 0.97											0.98028	0.98145
101.0											0.97976	0.98096
102.0											0.97924	0.98047
103.0											0.97872	0.97998
104.0 0.97064 0.97583 0.97056 0.97512 0.97617 0.97410 0.97595 0.97677 0.97500 0.977 105.0 0.96996 0.97528 0.96989 0.97456 0.97562 0.97351 0.97540 0.97504 0.97504 0.97504 0.97504 0.97504 0.9747 0.96821 0.97472 0.96821 0.97342 0.97485 0.97223 0.97485 0.97571 0.97448 0.9751 0.97480 0.97392 0.9751 0.97481 0.97392 0.9751 0.97392 0.97318 0.97392 0.9751 0.97392 0.9751 0.97392 0.97318 0.97392 0.9751 0.97392 0.97318 0.97392 0.97318 0.97393 0.97175 0.97374 0.97465 0.97336 0.97336 0.97510 0.97228 0.97345 0.97116 0.97318 0.97412 0.97280 0.97516 0.97216 0.97223 0.97411 0.97228 0.97345 0.97216 0.97336 0.97167 0.97263 0.97336 0.97336 0.97316											0.97820	0.97949
105.0 0.96996 0.97528 0.96989 0.97456 0.97562 0.97351 0.97540 0.97624 0.97504 10.9764 106.0 0.96929 0.97472 0.96921 0.97399 0.97508 0.97292 0.97485 0.97518 0.97351 0.97518 0.97571 0.97448 0.97448 0.97429 0.97518 0.97351 0.97518 0.97518 0.97351 0.97518 0.97351 0.97518 0.97351 0.97518 0.97351 0.97518 0.97362 0.97586 0.97285 0.97399 0.97175 0.97374 0.97465 0.97366 0.97191 0.97288 0.97345 0.97116 0.97318 0.97412 0.97280 0.974 110.0 0.96656 0.97251 0.96651 0.97171 0.97290 0.97057 0.97263 0.97359 0.97223 0.9741 110.0 0.96656 0.97196 0.96583 0.97114 0.97236 0.96998 0.97207 0.97306 0.97167 0.973 1112.0 0.96520 0.97140 0.96516 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.97768</td><td>0.97900</td></td<>											0.97768	0.97900
106.0 0.96929 0.97472 0.96921 0.97399 0.97508 0.97292 0.97485 0.97571 0.97448 0.973 107.0 0.96861 0.97417 0.96854 0.97342 0.97453 0.97233 0.97429 0.97518 0.97392 0.975 108.0 0.96793 0.97362 0.96786 0.97285 0.97399 0.97175 0.97374 0.97465 0.97336 0.9751 109.0 0.96725 0.97306 0.96719 0.97228 0.97345 0.97116 0.97318 0.97412 0.97228 0.97411 0.97263 0.97359 0.97223 0.974 110.0 0.96656 0.97251 0.96651 0.97171 0.97236 0.96998 0.97207 0.97306 0.97167 0.973 111.0 0.96588 0.97140 0.96516 0.97058 0.97181 0.96998 0.972152 0.97253 0.97111 0.973 112.0 0.96384 0.97029 0.96381 0.96701 0.97127 0.96880 0.97096<											0.97716	0.97852
107.0 0.96861 0.97417 0.96854 0.97342 0.97453 0.97233 0.97429 0.97518 0.97392 0.9736 108.0 0.96793 0.97362 0.96786 0.97285 0.97399 0.97175 0.97346 0.97336 0.975 109.0 0.96725 0.97306 0.96719 0.97228 0.97345 0.97116 0.97318 0.97412 0.97280 0.974 110.0 0.96656 0.97251 0.96651 0.97171 0.97290 0.97057 0.97263 0.97399 0.97223 0.974 111.0 0.96588 0.97196 0.96583 0.97114 0.97236 0.96998 0.97207 0.97306 0.97167 0.973 112.0 0.96520 0.97140 0.96516 0.97058 0.97181 0.96939 0.97152 0.97253 0.97111 0.973 112.0 0.96384 0.97029 0.96311 0.96844 0.97073 0.96821 0.97199 0.97055 0.972 114.0 0.96315											0.97664	0.97803
108.0 0.96793 0.97362 0.96786 0.97285 0.97399 0.97175 0.97374 0.97465 0.97336 0.9736 109.0 0.96725 0.97306 0.96719 0.97228 0.97345 0.97116 0.97318 0.97412 0.97280 0.974 110.0 0.965656 0.97251 0.96651 0.97171 0.97236 0.96998 0.97207 0.97306 0.97167 0.973 111.0 0.96520 0.97140 0.96583 0.97114 0.97236 0.96998 0.97207 0.97306 0.97167 0.973 112.0 0.96520 0.97140 0.96516 0.97058 0.97181 0.96939 0.97152 0.97253 0.97111 0.973 113.0 0.96452 0.97085 0.96448 0.97001 0.97127 0.96880 0.97096 0.97199 0.97055 0.972 114.0 0.96384 0.97029 0.96381 0.96944 0.97073 0.96820 0.97040 0.97146 0.96998 0.971											0.97612	0.97754
109.0 0.96725 0.97306 0.96719 0.97228 0.97345 0.97116 0.97318 0.97412 0.97280 0.974 110.0 0.96656 0.97251 0.96651 0.97171 0.97290 0.97057 0.97263 0.97359 0.97223 0.973 111.0 0.96588 0.97196 0.96583 0.97114 0.97236 0.96998 0.97207 0.97306 0.97167 0.973 112.0 0.96620 0.97140 0.96516 0.97058 0.97181 0.96939 0.97152 0.97253 0.97111 0.973 113.0 0.96452 0.97085 0.96448 0.97001 0.97127 0.96880 0.97096 0.97199 0.97055 0.972 114.0 0.96384 0.97029 0.96381 0.96944 0.97073 0.96821 0.97040 0.97146 0.96998 0.971 115.0 0.96315 0.96974 0.96313 0.96887 0.97018 0.96763 0.96985 0.97093 0.96442 0.971											0.97560	0.97705
110.0 0.96656 0.97251 0.96651 0.97171 0.97290 0.97057 0.97263 0.97359 0.97223 0.974 111.0 0.96588 0.97196 0.96583 0.97114 0.97236 0.96998 0.97207 0.97306 0.97167 0.973 112.0 0.96520 0.97140 0.96516 0.97058 0.97181 0.96939 0.97152 0.97253 0.97111 0.973 113.0 0.96452 0.97085 0.96448 0.97001 0.97127 0.96880 0.97096 0.97199 0.97055 0.972 114.0 0.96384 0.97029 0.96381 0.96944 0.97073 0.96821 0.97040 0.97146 0.96998 0.971 115.0 0.96315 0.96974 0.96313 0.96887 0.97018 0.96763 0.96985 0.97093 0.96942 0.971 116.0 0.96247 0.96918 0.96245 0.96830 0.96964 0.96704 0.96929 0.97040 0.96886 0.970											0.97508	0.97656
111.0 0.96588 0.97196 0.96583 0.97114 0.97236 0.96998 0.97207 0.97306 0.97167 0.9731 112.0 0.96520 0.97140 0.96516 0.97058 0.97181 0.96939 0.97152 0.97253 0.97111 0.973 113.0 0.96452 0.97085 0.96448 0.97001 0.97127 0.96880 0.97096 0.97199 0.97055 0.972 114.0 0.96384 0.97029 0.96381 0.96944 0.97073 0.96821 0.97040 0.97146 0.96998 0.971 115.0 0.96315 0.96974 0.96313 0.96887 0.97018 0.96763 0.96985 0.97093 0.96942 0.971 116.0 0.96247 0.96918 0.96245 0.96830 0.96964 0.96704 0.96929 0.97040 0.96886 0.971 117.0 0.96178 0.96818 0.96773 0.96964 0.96645 0.96873 0.96987 0.96830 0.96773 118.0											0.97456	0.97607
112.0 0.96520 0.97140 0.96516 0.97058 0.97181 0.96939 0.97152 0.97253 0.97111 0.97311 113.0 0.96452 0.97085 0.96448 0.97001 0.97127 0.96880 0.97096 0.97199 0.97055 0.972 114.0 0.96384 0.97029 0.96381 0.96944 0.97073 0.96821 0.97040 0.97146 0.96998 0.971 115.0 0.96315 0.96974 0.96313 0.96887 0.97018 0.96763 0.96985 0.97093 0.96942 0.971 116.0 0.96247 0.96918 0.96245 0.96830 0.96964 0.96704 0.96929 0.97040 0.96886 0.971 117.0 0.96178 0.96645 0.96890 0.96645 0.96873 0.96987 0.96830 0.970 118.0 0.96110 0.96857 0.96659 0.96855 0.96886 0.96873 0.96887 0.96877 0.9689 120.0 0.95973 0.96696											0.97404	0.97558
113.0 0.96452 0.97085 0.96448 0.97001 0.97127 0.96880 0.97096 0.97199 0.97055 0.972 114.0 0.96384 0.97029 0.96381 0.96944 0.97073 0.96821 0.97040 0.97146 0.96998 0.971 115.0 0.96315 0.96974 0.96313 0.96887 0.97018 0.96763 0.96985 0.97093 0.96942 0.971 116.0 0.96247 0.96918 0.96245 0.96830 0.96964 0.96704 0.96929 0.97040 0.96886 0.970 117.0 0.96178 0.96863 0.96773 0.96909 0.96645 0.96873 0.96987 0.96830 0.970 118.0 0.96110 0.96818 0.96716 0.96855 0.96886 0.96933 0.96773 0.969 119.0 0.96041 0.96752 0.96042 0.96659 0.96850 0.96880 0.96717 0.969 120.0 0.95973 0.96696 0.95974 0.96602											0.97352	0.97509
114.0 0.96384 0.97029 0.96381 0.96944 0.97073 0.96821 0.97040 0.97146 0.96998 0.971 115.0 0.96315 0.96974 0.96313 0.96887 0.97018 0.96763 0.96985 0.97093 0.96942 0.971 116.0 0.96247 0.96918 0.96245 0.96830 0.96964 0.96704 0.96929 0.97040 0.96886 0.970 117.0 0.96178 0.96863 0.96178 0.96773 0.96909 0.96645 0.96873 0.96987 0.96830 0.9671 118.0 0.96110 0.96617 0.96716 0.96855 0.96886 0.96818 0.96933 0.96773 0.969 119.0 0.96041 0.96752 0.96642 0.96659 0.96800 0.96527 0.96762 0.96880 0.96717 0.968 120.0 0.95973 0.96696 0.95974 0.96602 0.96746 0.96468 0.96706 0.96827 0.96660 0.96746 0.96468 0.96774 </td <td></td> <td>0.97300</td> <td>0.97460</td>											0.97300	0.97460
115.0 0.96315 0.96974 0.96313 0.96887 0.97018 0.96763 0.96985 0.97093 0.96942 0.971 116.0 0.96247 0.96918 0.96245 0.96830 0.96964 0.96704 0.96929 0.97040 0.96886 0.970 117.0 0.96178 0.96863 0.96178 0.96773 0.96909 0.96645 0.96873 0.96987 0.96830 0.970 118.0 0.96110 0.96176 0.96855 0.96586 0.96818 0.96933 0.96773 0.969 119.0 0.96041 0.96752 0.96042 0.96659 0.96800 0.96527 0.96762 0.96880 0.96717 0.969 120.0 0.95973 0.96696 0.95974 0.96602 0.96746 0.96468 0.96706 0.96880 0.96717 0.968 121.0 0.95904 0.96641 0.95906 0.96546 0.96691 0.96409 0.96550 0.96774 0.96604 0.968 122.0 0.95836												0.97411
116.0 0.96247 0.96918 0.96245 0.96830 0.96964 0.96704 0.96929 0.97040 0.96886 0.970 117.0 0.96178 0.96863 0.96178 0.96773 0.96909 0.96645 0.96873 0.96987 0.96830 0.970 118.0 0.96110 0.96807 0.96110 0.96716 0.96855 0.96586 0.96818 0.96933 0.96773 0.969 119.0 0.96041 0.96752 0.96642 0.96659 0.96800 0.96527 0.96762 0.96880 0.96717 0.969 120.0 0.95973 0.96696 0.95974 0.96602 0.96746 0.96468 0.96706 0.96827 0.96600 0.968 121.0 0.95904 0.96540 0.96546 0.96691 0.96409 0.96650 0.96774 0.96604 0.968 122.0 0.95836 0.96585 0.95839 0.96489 0.96637 0.96350 0.96570 0.96548 0.967 123.0 0.95767												0.97362
117.0 0.96178 0.96863 0.96178 0.96773 0.96909 0.96645 0.96873 0.96987 0.96830 0.970 118.0 0.96110 0.96807 0.96110 0.96716 0.96855 0.96886 0.96818 0.96933 0.96773 0.968 119.0 0.96041 0.96752 0.96042 0.96659 0.96800 0.96527 0.96762 0.96880 0.96717 0.969 120.0 0.95973 0.96696 0.95974 0.96602 0.96746 0.96488 0.96706 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96827 0.96600 0.96820 0.96350 0.96520 0.96548 0.967												0.97313
118.0 0.96110 0.96807 0.96110 0.96716 0.96855 0.96586 0.96818 0.96933 0.96773 0.96931 119.0 0.96041 0.96752 0.96042 0.96659 0.96800 0.96527 0.96762 0.96880 0.96717 0.9693 120.0 0.95973 0.96696 0.95974 0.96602 0.96746 0.96468 0.96706 0.96827 0.96660 0.96827 121.0 0.95904 0.96641 0.95906 0.96546 0.96691 0.96409 0.96650 0.96774 0.96604 0.9684 122.0 0.95836 0.96585 0.95839 0.96489 0.96637 0.96350 0.96574 0.96720 0.96548 0.967 123.0 0.95767 0.96529 0.95771 0.96432 0.96582 0.96292 0.96538 0.96667 0.96471 0.96471 0.96471 0.96471 0.96472 0.96473 0.96667 0.96473 0.96474 0.96473 0.96473 0.96473 0.96474 0.96473												0.97264
119.0 0.96041 0.96752 0.96042 0.96659 0.96800 0.96527 0.96762 0.96880 0.96717 0.9689 120.0 0.95973 0.96696 0.95974 0.96602 0.96746 0.96468 0.96706 0.96827 0.96660 0.9688 121.0 0.95904 0.96641 0.95906 0.96546 0.96691 0.96409 0.96650 0.96774 0.96604 0.968 122.0 0.95836 0.96585 0.95839 0.964697 0.96350 0.96594 0.96720 0.96548 0.967 123.0 0.95676 0.96529 0.95771 0.96432 0.96582 0.96292 0.96538 0.96667 0.96491 0.967 124.0 0.95698 0.96474 0.95703 0.96375 0.96528 0.96233 0.96483 0.96614 0.96435 0.968 125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.966 126.0	117.0	0.96178			0.96773	0.96909	0.96645	0.96873	0.96987	0.96830	0.97040	0.97215
120.0 0.95973 0.96696 0.95974 0.96602 0.96746 0.96468 0.96706 0.96827 0.96660 0.9688 121.0 0.95904 0.96641 0.95906 0.96546 0.96691 0.96409 0.96650 0.96774 0.96604 0.968 122.0 0.95836 0.96585 0.95839 0.96489 0.96637 0.96350 0.96594 0.96720 0.96548 0.967 123.0 0.95767 0.96529 0.95771 0.96432 0.96582 0.96292 0.96538 0.96667 0.96491 0.967 124.0 0.95698 0.96474 0.95703 0.96375 0.96528 0.96233 0.96483 0.96614 0.96435 0.963 125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.963 126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965											0.96988	0.97166
121.0 0.95904 0.96641 0.95906 0.96546 0.96691 0.96409 0.96650 0.96774 0.96604 0.968 122.0 0.95836 0.96585 0.95839 0.96489 0.96637 0.96350 0.96594 0.96720 0.96548 0.967 123.0 0.95767 0.96529 0.95771 0.96432 0.96582 0.96292 0.96538 0.96667 0.96491 0.967 124.0 0.95698 0.96474 0.95703 0.96375 0.96528 0.96233 0.96483 0.96614 0.96435 0.963 125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.966 126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965 127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.963 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.9											0.96936	0.97117
122.0 0.95836 0.96585 0.95839 0.96489 0.96637 0.96350 0.96594 0.96720 0.96548 0.967 123.0 0.95767 0.96529 0.95771 0.96432 0.96582 0.96292 0.96538 0.96667 0.96491 0.967 124.0 0.95698 0.96474 0.95703 0.96375 0.96528 0.96233 0.96483 0.96614 0.96435 0.966 125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.966 126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965 127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.963 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964	120.0	0.95973	0.96696	0.95974	0.96602	0.96746	0.96468	0.96706	0.96827	0.96660	0.96884	0.97068
123.0 0.95767 0.96529 0.95771 0.96432 0.96582 0.96292 0.96538 0.96667 0.96491 0.967 124.0 0.95698 0.96474 0.95703 0.96375 0.96528 0.96233 0.96483 0.96614 0.96435 0.966 125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.966 126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965 127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.963 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964	121.0	0.95904	0.96641	0.95906	0.96546	0.96691	0.96409	0.96650	0.96774	0.96604	0.96832	0.97019
124.0 0.95698 0.96474 0.95703 0.96375 0.96528 0.96233 0.96483 0.96614 0.96435 0.966 125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.966 126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965 127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.963 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964	122.0	0.95836	0.96585	0.95839	0.96489	0.96637	0.96350	0.96594	0.96720	0.96548	0.96780	0.96970
124.0 0.95698 0.96474 0.95703 0.96375 0.96528 0.96233 0.96483 0.96614 0.96435 0.966 125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.966 126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965 127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.963 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964											0.96728	0.96921
125.0 0.95629 0.96418 0.95635 0.96318 0.96473 0.96174 0.96427 0.96560 0.96378 0.9667 126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965 127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.965 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964											0.96676	0.96872
126.0 0.95560 0.96362 0.95567 0.96261 0.96418 0.96115 0.96371 0.96507 0.96321 0.965 127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.965 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964											0.96624	0.96823
127.0 0.95492 0.96307 0.95499 0.96205 0.96364 0.96056 0.96315 0.96453 0.96265 0.965 128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964											0.96572	0.96773
128.0 0.95423 0.96251 0.95431 0.96148 0.96309 0.95997 0.96258 0.96400 0.96208 0.964											0.96520	0.96724
												0.96675
129.0 0.95354 0.96195 0.95363 0.96091 0.96255 0.95938 0.96202 0.96347 0.96152 0.964	129.0	0.95354	0.96195	0.95363	0.96091	0.96255	0.95938	0.96202	0.96347	0.96152		0.96626
												0.96577
											0.96312	0.96528
											0.96260	0.96479
											0.96208	0.96479
											0.96156	0.96381
											0.96104 0.96052	0.96332 0.96283

TABLE 4 Continued

		Volume Correction to 60°F										
Temperature °F	Benzene	Cumene	Cyclohexane	Ethylbenzene	Styrene	Toluene	m-Xylene and Mixed Xylenes	o-Xylene	<i>p</i> -Xylene	300 to 350° Aromatic Hydrocarbons	350 to 400° Aromatic Hydrocarbons	
137.0	0.94800	0.95749	0.94819	0.95637	0.95818	0.95468	0.95752	0.95919	0.98698	0.96000	0.96234	
138.0	0.94730	0.95693	0.94751	0.95580	0.95763	0.95409	0.95696	0.95865	0.95641	0.95948	0.96184	
139.0	0.94661	0.95637	0.94683	0.95524	0.95708	0.95350	0.95640	0.95811	0.95584	0.95896	0.96135	
140.0	0.94591	0.95581	0.94614	0.95467	0.95654	0.95291	0.95583	0.95758	0.95528	0.95844	0.96086	
141.0									0.95471			
142.0									0.95414			
143.0									0.95357			
144.0									0.95300			
145.0									0.95243			
146.0									0.95186			
147.0									0.95129			
148.0									0.95072			
149.0									0.95015			
150.0									0.94958			

6.2 Converting Volume to Weight for Mixtures—Chemicals Listed in Table 1—CorrectConvert the measured bulk volume to gallons at 60°F as described in 6.1. Determine the density (all weights in vacuo) at 60°F in grams per milliliter (equivalent to grams per cubic centimetre, they are equivalent) centimeter and kilograms per liter) as described in Section 7. To obtain the density in weight multiply the density in pound per gallon and the volume in gallons. To obtain the density in pounds per gallon in vacuo, vacuo multiply by the factor described in footnote C of multiple the measured density by 8.345404452. Table 1. To obtain the density in pounds per gallon in air at 60°F, use the equation described in footnote D of following equation to determine the pound per Table 1 gallon (or in air, refer to Appendix X3).

 $\begin{array}{c} D_{\text{lb per gallon } in \ air \ \text{at } 60 \, \text{F}} \ = \ \begin{bmatrix} 1.000149926 \times D_{in \ vacuo \ \text{at } 60 \, \text{F}} \\ - \ 0.00119940779543 \end{bmatrix} \times 8.345404452 \end{array}$

To obtain the weight in pounds, multiply the density in pounds per gallon by the volume in gallons.

6.2.1 Example 3—If The density of the p-xylene in Example 2 is less than 100 % pure, its density should be determined by actual measurement. For 1 was determined by Test Method D4052 instance, if the p-xylene is 95 % pure and its density has been measured and determined to be 0.8651 to be 0.8646 g/mL (in vacuo) at 60°F, the density in lb/gal is:60°F. The weight is:

 $\begin{array}{c} (0.8651\cdot 8.345404438) \\ \hline ASTM = 7.2196 \text{ lb/gal in } \textit{vacuo} \\ \hline \text{https://standards.} & 9280 \text{ gal} \times 0.984143256178277 \times 8.345404452 \times 0.8646 \\ \hline \\ \text{or} \\ \hline \\ & (0.8651\cdot 1.00014992597 - 0.00119940779543)\cdot 8.34540438 = 7.2107 \\ \hline \\ & (0.8651\cdot 1.00014992597 \times 8.345404452) \\ \hline \\ & 9280 \text{ gal} \times 0.984143256178277 \times 8.345404452} \\ \hline \\ & \times [1.000149926 \times 0.8646 - 0.0011994077951] \\ = 65.815.960860521 \text{ lb}_{in, vacio} \\ \hline \end{array}$